The Insect Collector's Guide

Entomological Society of Alberta

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INTRODUCTION

Entomology is the study of insects. Collecting and preserving insects is a basic part of this study and is one of the best ways to learn about insects, how they live and how they affect humans. People often start collecting insects for the fun of it and then want to know more about the insects collected, their correct scientific and common names, and how they spend their lives.

Importance of Insects

Insects are the most numerous and diverse group of animals. Over 790,000 species have been described, far more than for any other animal or plant group. For example, there are about 80,000 species of molluscs (clams, snails and squids), 55,000 species of Arachnids (spiders, scorpions, ticks) and 54,000 species of vertebrates (birds, mammals, fish, reptiles and amphibians). The order Coleoptera (beetles) has 350,000 species, Diptera (flies) has 120,000 species, Lepidoptera (moths and butterflies) has 112,000 species and Hymenoptera (bees and wasps) has 108,000 species.

With such large numbers, it is not surprising that insects play a number of important ecological roles. Insects occur at all levels of the food web, (except as primary producers) and play important roles as detritivores (scavengers), herbivores (plant feeders), predators, and parasites.

Insects can be important pests in agriculture, forestry and homes, and can threaten human health. Populations of insects can reach high numbers and cause a significant amount of damage unless control measures are taken against them. Insects also have a variety of beneficial roles. They are necessary for pollinating many plants, including important fruit and vegetable crops. Insects can also feed on other insects and provide checks on the populations of pest insects, preventing them from reaching damaging levels. Biological control agents can be purchased and used in agriculture and the home garden to reduce pesticide use.

Insects themselves are the basic food for many other organisms such as birds, fish, and mammals. Trout sports fisheries depend heavily on populations insects. Caddisflies, stoneflies, mayflies, dragonflies, damselflies, mosquitoes, midges, and beetles are all prey for trout. Insects are also sources of human food in many areas. Locusts and grasshoppers are eaten in Oriental countries, giant skipper larvae (65 mm long) are eaten in Mexico and beetles, ants, termites and caterpillars are eaten in Africa and Australia. In addition to food, insects also provide a large number of commercial products such as honey, beeswax, shellac, silk and dyes.

Insects directly affect human health by transmitting important diseases such as malaria, typhus, plague and yellow fever. Stinging and biting insects can cause annoyance, parasitize humans, inject venom and produce allergens.

It is important to remember that there are only a few thousand different species of insects that warrant a reputation as destructive insects which are so harmful to humans, crops, stored foods and domestic animals that steps are taken to control them. Several thousand species of insects can be considered beneficial, but the majority of insects do neither appreciable harm nor good, and can be considered indifferent insects. Useful insects can become destructive or indifferent, or vice versa, by a change in

the balance of nature. Sometimes this results from human activities such as clearing forests and breaking farm land or from nature's changing climate cycle. We must always remember to be on guard by knowing all we can about insects to be ready when an indifferent insect or a good insect becomes destructive.

DEVELOPMENT AND STRUCTURE

Almost all insects start life as an egg, although a few species bear live young. Insect eggs are usually as small as or smaller than the head of a pin. Their shape is various among species as are the color and texture of the egg shell. Cockroaches and related insects enclose a number of eggs within one egg case. Lacewings lay their eggs on long stalks so the first larva cannot eat the other eggs before they hatch. Some species lay only a few eggs and others many thousands. Ordinarily, only one insect hatches from one egg but several thousand insects may develop from a single egg of some parasites. Most eggs are laid close to or on the food the young require, but some are scattered randomly throughout the environment. The larva hatches from an egg and develops into the adult.

The skin of an insect is somewhat rigid and acts as its skeleton, but also limits the amount of growth that can occur. As the insect feeds, it grows until its skin can no longer stretch. It then stops feeding for a short period and completes the development of a new and larger (looser) skin underneath the old one. It swells its body by swallowing air or water and also by flexing its muscles. This splits the old skin and the insect crawls out. This process is called molting. Every time an immature insect molts it may change its appearance slightly as well as becoming larger. The form of an insect between molts is called an instar. All immatures of a certain instar of a species will look the same. The number of instars that insects must go through before it reaching maturity (adult stage), varies among species, but is commonly three to five.

Immature insects undergo changes in form before reaching the adult stage. This process is called metamorphosis, which in Greek means change of form. Metamorphosis has three basic types. The first type is found in the most primitive insects and is called ametablous metamorphosis because there is no metamorphosis. The newly hatched insect looks almost exactly like the adult insect except that it is smaller. Silverfish are ametabolous insects.

The second type is hemimetabolous metamorphosis. The newly hatched insect is called a nymph which closely resembles the adult insect, except it does not have wings. The wings appear as small pads on the back of the nymph and get larger at each moult. When the nymph reaches the size of an adult, it molts to the adult form with fully grown wings. Grasshoppers, lice and bugs are hemimetabolous insects.

The third type of metamorphosis is holometabolous metamorphosis or complete metamorphosis. The insect hatches from the egg as a larva, which does not resemble the adult insect. Some examples of larvae are caterpillars, fly maggots, wireworms, and mosquito wrigglers. After a larva reaches full size it turns into a pupa. The pupa is often enclosed in a bundle of silk or a wrapping of leaves or ground trash, which is called the cocoon. Usually the mature larva crawls to a protected place or burrows into the ground before it

turns into a pupa. Inside the pupal case the insect turns into the adult which emerges to complete the life cycle. Examples of adult holometabolous insects are beetles, butterflies, moths, mosquitoes, bees, and flies.

Adult insects have common basic structures. The insect body has three main parts (Figure 1), the head, thorax, and abdomen. Each of these bears appendages (e.g., antennae, mouthparts, and legs) common to all adult insects, although they vary among different species. The shape and size of the appendages depends upon their use.

Appendages on the head are antennae and mouthparts. Antennae of different species of insects vary greatly in shape and size as do the shapes of the mouthparts. Also on the head of adult insects are a pair of large compound eyes and usually two or three ocelli or simple eyes.

The thorax is made up of three segments and has three pairs of legs (one pair on each segment) and usually two pairs of wings (one pair on each of the last two segments). Wings, which are variously modified among groups of insects, are important for classification. The hard shell covering the back of a beetle's body is the front pair of wings. These are called elytra and are modified to protect the hind wings. In flies (Diptera), the hind wings are tiny and resemble small drum sticks.

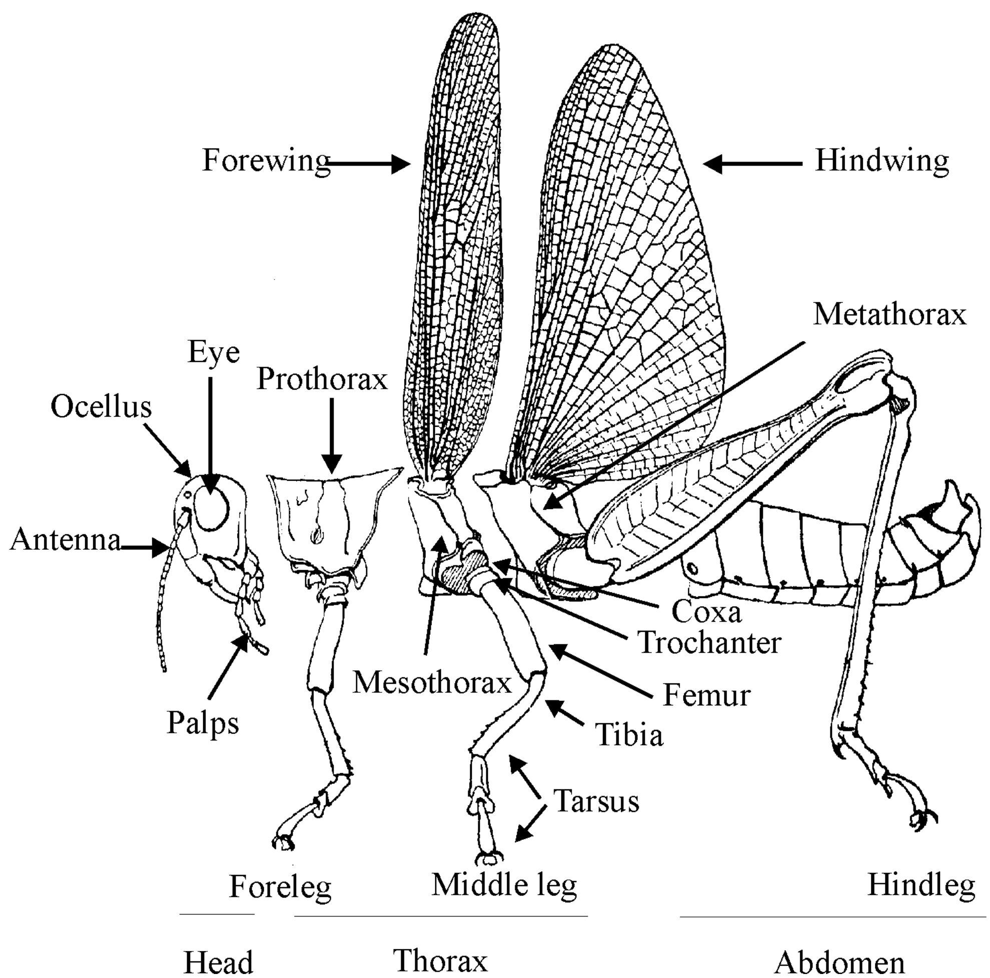


Figure 1

The abdomen of an insect is composed of up to twelve segments. The number showing on various species may be as few as four or as many as nine or ten. The appendages on the abdomen of adult insects are mostly confined to the last few segments. These appendages on females are concerned with laying eggs and, collectively, are called the ovipositor. An example of an insect with a large ovipositor is the field cricket. Many insects have no ovipositor visible because it is withdrawn inside the abdomen. The sting of a bee or wasp is a modified ovipositor. The abdominal appendages of males are concerned with mating. Both sexes may have additional appendages, which often resemble the antennae in both form and function.

COLLECTING INSECTS

There are several ways to make an insect collection. Most often, people make collections of every kind of insect they can catch. This allows the collector to learn to recognize the various insect groups. Another type of collection consists of only one kind of insect such as only butterflies or only beetles. This makes a nice collection for someone who wants to specialize, but first a collector should know something about all kinds of insects. A locality collection contains only those insects caught in a certain locality such as your own back yard, town or farm, or home province. In New York City, one man caught and identified about two thousand different species in his own back yard.

A life history collection shows all stages of an insect species and examples of what they feed on and can show the damage they do. Each species and its food sample are mounted in a single box.

Insect larvae are best preserved in bottles or vials of alcohol (70% ethanol). Almost any insect can be preserved in this way but they do not appear as neat as when pinned and dried and mounted in a box. Alcohol collections of insects are quite important for larvae and small, soft-bodied insects such as aphids, as well as for related animals such as spiders.

COLLECTING EQUIPMENT

The equipment needed to start collecting is fairly simple and inexpensive. Most equipment can be made at home, or purchased from nature supply stores. Essential equipment includes a collecting net, killing bottles, insect pins, pinning block, forceps or tweezers, scissors, pinning forceps or pliers, spreading board for butterflies and moths, insect labels, specimen boxes, a fine pen and India ink.

Insect Collecting Nets.

Insect collecting nets make the capture of a great many insects much easier and when used properly, prevents damaging the captured insect. Nets can be made with a broom handle, 150 cm of thick stiff wire bent into a hoop, cord or soft wire or 10 cm of tubing to fasten the hoop to the broom handle, and a piece of fine mesh cloth (mosquito netting, nylon organdy or marquisette). The details of construction of the net are illustrated in Figure 2.

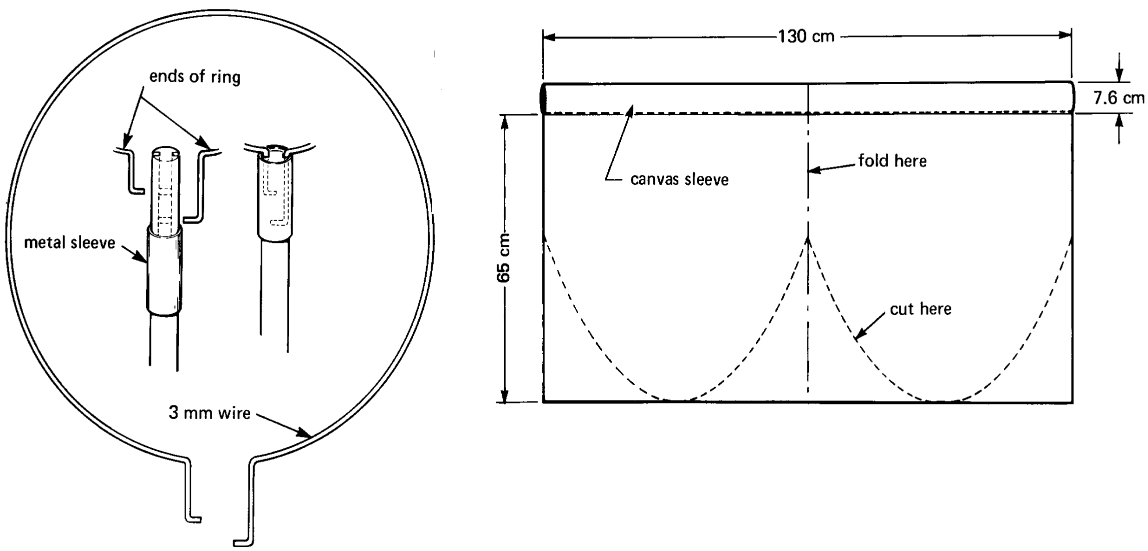


Figure 2

Killing Bottles.

Insects must be killed before pinning. Killing bottles are quick and efficient, but must be properly made and used as they contain poisonous materials. A variety of chemicals can be used as the killing agent, but many of the chemicals recommended in the earlier literature are toxic to humans and should be avoided. Ethyl acetate is reasonably safe to humans and will kill insects in less than an hour. You should always avoid inhaling the fumes and use the killing bottle only in a well-ventilated area. Ethyl acetate is also inflammable and should not be used near furnaces, flames or other sources of heat.

Killing bottles are generally made by placing an absorbent material on the bottom of a jar and adding a few drops of ethyl acetate prior to use. Glass bottles or vials must be used as ethyl acetate dissolves plastic. The bottles should have a tight-fitting lid and should also be wrapped on the outside with electrician's tape to avoid injury in case of breakage. You should have a number of jars of various sizes to avoid overcrowding and reduce the possibility of specimens damaging each other. The size of the killing bottle depends on the size of the insect being killed. Moths and butterflies, for example, require larger bottles than beetles and flies.

Butterflies can be killed without poisons by pinching the under side of the thorax. Many insects can also be killed by placing them in a freezer for several hours. However, freezing may not be effective in the fall as many insects become cold-hardy in preparation for the winter.

Insect Pins, Pinning Blocks, and Forceps

Insect pins are fine steel pins, blue, black, or silver in color, with a small round head, and are specifically made

for pinning insects. They are available in various thickness but are almost all the same length. Ordinary pins are too short and thick to be useful for pinning insects. The thickness of insect pins is indicated by numbers. The most commonly used size is No. 2 or 3. Either size will do for pinning almost any insect except very small ones. Figures 3 and 4 show the correct places on various insects through which a pin should be put to pin them properly.

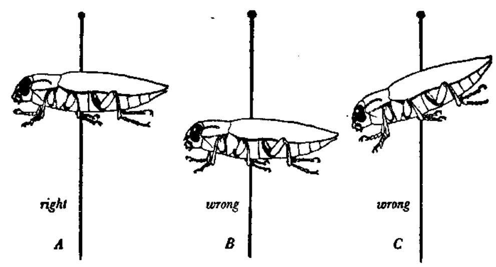


Figure 3

Small insects are pinned using special methods (Figure 5). Small triangles of stiff cardboard about 1.0 cm long are cut. The insect pin is pushed through the broad end of the triangle and the

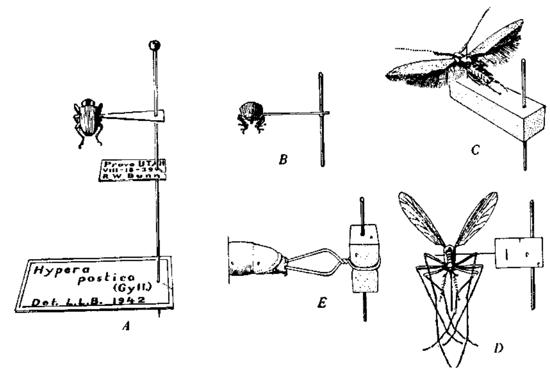


Figure 5

triangle raised to the proper height on the pin. The tip of the triangle is then bent downward to match the angle of the insects' thorax, and the insect is glued onto this end of the triangle using a quick- drying glue. The point of the

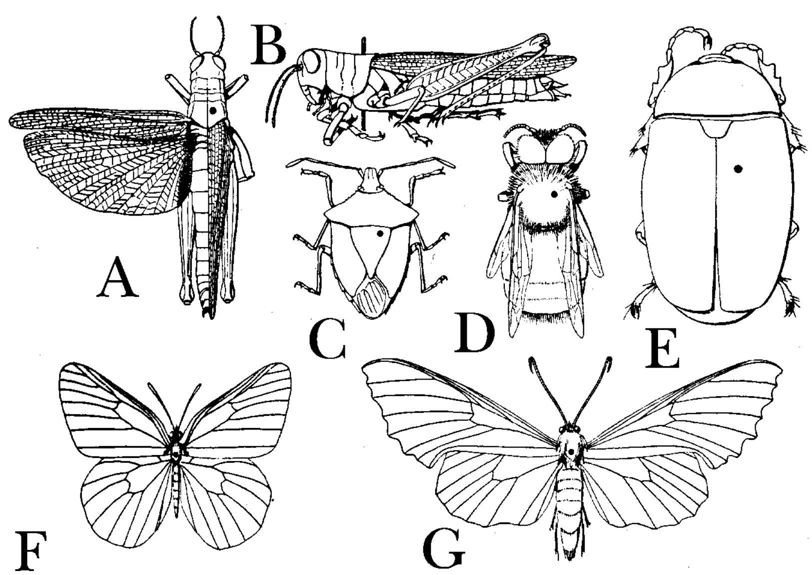


Figure 4

triangle should touch the right-hand side of the insect's body just above the legs. This pinning method should be used only for small insects that would be damaged by pushing a size 2 or 3 insect pin through the thorax. Some insects may be glued directly to the side of a No. 2 pin.

A pinning block, (Figure 6) is a necessity for positioning insects and labels at the correct height on the pins. The block measures 7.5 cm long and 2.5 cm wide and consists of three steps. The first step is 0.6 cm high, the second 1.2 cm and the third 2.2 cm high. In the centre of each step a small diameter hole (0.16 cm) is drilled .

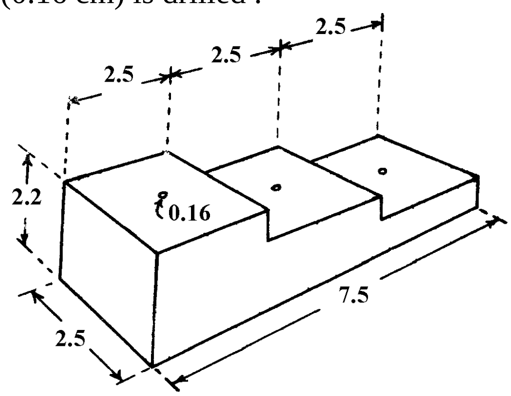


Figure 6 All sizes in cm

The highest and lowest steps of the pinning block are used to position insects at the correct height on insect pins. Once the pin is properly inserted through the insect's body, the insect is placed on the highest step of the pinning block with the point of the pin in the small hole in the centre of the block. The pin is pushed through the insect to the bottom of the hole. This moves the insect up near the head of the pin almost at the height it should be. However, it is better to have the top of each insect a standard distance (usually 1.0 cm) from the top of each pin rather than the bottom of each insect a standard distance from the point of the pin. Use a ruler to measure from the pin top to the top of the insect. The middle step of the pinning block is used to locate the height on the pin at which the locality and collector's label should be placed (Figure 5). Pierce the label in the centre with the point of the insect pin (the insect is already at the right place on the pin). Place the point of the pin in the hole through the middle step of the block and push it to the bottom of the hole. The lowest step of the block may be used similarly to place the identity label on the pin. Make sure that all your labels read in the same direction, with their length the same direction as the length of the insect or width of a large butterfly.

A small pair of scissors is handy for cutting out insect labels and for cutting stiff pieces of smooth paper for spreading moths and butterflies on spreading boards. A pair of fairly large, fine-pointed forceps and a pair of flat-pointed forceps are very useful for handling smaller insects and moths and butterflies. Moths and butterflies should never be handled with the fingers because the scales on the wings are easily rubbed off and the specimen become damaged.

Spreading Boards and Relaxing Boxes

Spreading boards are used to mount moths, butterflies, and other insects that should have their wings spread flat and evenly. Spreading the wings exposes markings and coloration useful in identifying insects. All moths and butterflies should be mounted with their wings spread flat and in the correct position. Grasshoppers are often mounted with only the right wings

spread to show the color of the underwing. Dragonflies and damsel flies look neater if their wings are spread on a spreading board, but it is not a requirement

Materials used to make a spreading board are two strips of soft wood 30 cm long, 5 cm wide, and 0.6 cm thick; two blocks of wood 13 cm by 5 cm by 1.2 cm, and a piece of thick composition cork material or soft wall board 30 cm by 5 cm. The spreading board is made by nailing the two larger wooden slats to the smaller wooden blocks (one block at each end), leaving an even 0.6 cm between the two long slats. The cork material or wall board is nailed or glued beneath the crack between the two long wooden slats. The spreading board should look similar that in Figure 7.

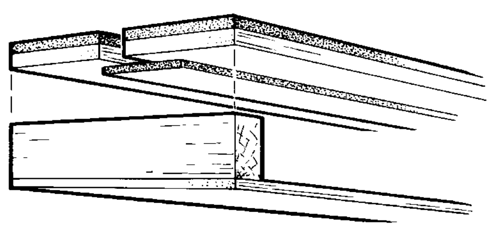


Figure 7

It is useful to have more than one spreading board so a number of insects can be mounted at one time. At least six insects can be mounted at a time on one board. Spreading boards may also be made with different sized-gaps between the long wooden slats to accommodate insects with various sizes of bodies. Professional spreading boards are often made so the gap between the two wooden slats is adjustable.

To spread an insect's wings, first mount it on a pin as usual and set it at the correct height using the pinning block (Figure 8).

The pin with the insect on it is then thrust through the cork material at slightly to the right of the centre of the spreading board. The pin must go

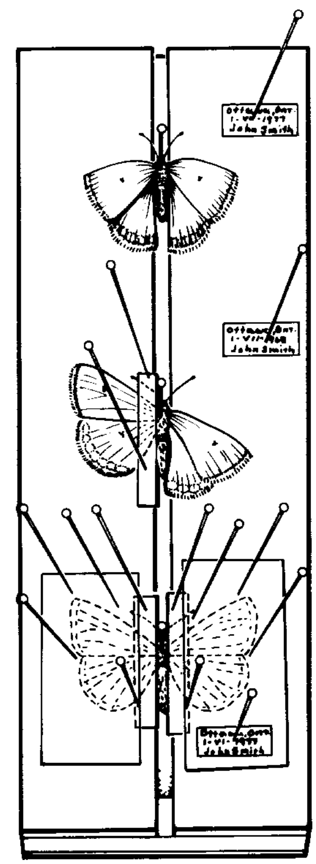


Figure 8

through this near centre line of the cork so that when the pin is pushed down, the body of the insect will slip evenly into the space between the two boards. Insert the pin deep enough so the bases of the insect's wings are exactly level with the top surface of the boards. If the insect wings are folded either upward or downward they must be eased along until they lie flat on the surface of the two side boards. Then, with the point of an insect pin, and without tearing or putting any holes in the wings, carefully move the front wings forward until rear

margin edges of them are at right angles to the insect's body. Then carefully move the hind wings until about two thirds of the front margin of the rear wing is covered up. The wings must then be held in position and pressed flat on the board by pinning across them pieces of relatively stiff, smooth paper. The pins holding the paper down should not go through the wings of the insect. Lace pins, with large glass heads are best for this purpose as they are more easily pushed into the wood. Specimens should be left on the board in a well-ventilated place protected from mice and cockroaches for a week to ten days to dry. Experience and practice are important in spreading wings properly.

Often, some time elapses between the killing of an insect and its mounting. Specimens can become dry and brittle, making it impossible to pin them without damaging them. Dried insects should be relaxed by placing it in a damp atmosphere for a few days. This is what relaxing boxes are for. Most relaxing boxes are made of large jars or plastic food containers with tight-fitting lids. A piece of soft wood that fits inside the container is placed on the bottom. When the container is to be used, a little water is poured underneath the wood (not enough to float the wood) and a few drops of ethyl acetate added to the water. The water provides a damp atmosphere and the ethyl acetate prevents mold from growing on the wood or on the insects in the container. In three to four days, the insects should be ready for mounting.

Labels and Specimen Boxes

Labels are one of the most important things about an insect collection as they identify where and when an insect was captured. Several different type of labels are used. The first and most important label is the locality label which bears the name of the nearest locality (town, city or village) in which the insect was caught, the date on which it was caught, and the name of the person who caught it.

An identification label bears the scientific name of the insect, the date it was identified, and the name of the person who identified it. Sometimes a third label is on the pin. It has on it various information such as the food the insect was eating when caught, or when it emerged as an adult if it was caught as an immature form and reared.

Insect labels must be as small as possible. The commonly used size measures 0.6 cm by 1.6 cm. They may be cut from good quality, stiff, white writing paper. The printing on the labels should be as small and as neat as possible. Labels can be made using a size 000 drafting pen, but excellent results can be obtained using a home computer, word-processing software and a laser printer. The following label was produced using the "Univers " font with a point size of 5

CANADA:ALBERTA:
Edmonton.670 m alt.
28.III.1995.R.Leech

Computer printed labels for several localities can be printed on the same sheet. The collector then cuts the labels from these sheets.

Insect specimens are quite easily damaged, and specimen boxes are essential for preserving them. They also afford a neat and orderly method of displaying the collection. Pasteboard boxes about 5 cm deep are ideal. Cut a piece of soft wall board to fit snugly into the bottom of the box and glue it there. Instead of wall board, thin composition

cork sheets obtainable from a hardware store, styrofoam from a florist or even thick corrugated cardboard will do. Cigar boxes lined in the bottom with this cork also make excellent specimen boxes. The soft wall board or cork is easy to stick pinned insects into and yet holds them there firmly. If possible, it is best to obtain students' specimen boxes or professional Schmitt boxes from a natural science supply house.

ORGANIZING A COLLECTION

There are many different kinds of insects. When this book was printed entomologists had classified and named almost one million different species of insects. It is believed that ten times this number of species may exist. The science of naming and classifying different kinds of plants and animals is called taxonomy.

In organizing an insect collection, we must first be able to decide what an insect is. The Class Insecta makes up one of the five most important living classes of the Phylum Arthropoda. The other four are the Arachnida (spiders, mites ticks, scorpions), the Crustacea (shrimps, crabs, lobsters, sowbugs, water fleas), the Chilopoda (centipedes) and the Diplopoda (millipedes). As long as you have a mature adult stage of an Arthropod, you should be able to decide the class to which it belongs by using the following key.

Key to Arthropod Classes - Adults

l. With five or more pairs of legs...........2

With three or four pairs of legs...........4

2. Body wormlike; head not fused with the thorax and provided with one pair of antennae or none............................ 3

Body not wormlike; head merged with the thorax and provided with two pairs of antennae ....**Crustacea** (crabs, lobsters, shrimp, sowbugs, etc.).

3. Body usually flattened, legs long, one pair of legs per segment, predatory and fast moving.................. **Chilopoda**

Body usually round in section, two pairs of small legs on most segments, not predatory, slow moving **Diplopoda**

4. Body composed of one or two main divisions, (fused head, thorax, abdomen); four pairs of legs and no antennae ....**Arachnida**

Body composed of three main divisions, the head, thorax and abdomen; only three pairs of jointed legs; antennae present ....**Insecta**

The Class Insecta is further divided into groups called orders. It is these orders of insects with which we shall mainly concern ourselves. However, note that orders are further subdivided into families, genera, and species.

The following is a list of orders of insects and examples of common names of insects belonging in those orders. This list will follow the order of evolution of insects, that is, those believed to be the most primitive types first and the most highly developed last.

AMETABOLA

Protura .... no common name
Thysanura .... silverfish
Collembola .... springtails, snow fleas

HEMIMETABOLA

Orthoptera .... grasshoppers, crickets
Dermaptera .... earwigs
Plecoptera .... stoneflies
Isoptera .... termites or white ants
Pscoptera .... book lice or bark lice
Phthiraptera .... sucking and biting lice
Ephemeroptera .... mayflies
Odonata .... dragonflies, damsel flies
Thysanoptera .... thrips
Hemiptera .... true bugs, aphids

HOLOMETABOLA

Neuroptera .... lacewings, ant lions
Mecoptera .... scorpion flies
Trichoptera .... caddis flies
Lepidoptera .... butterflies and moths
Coleoptera .... beetles and weevils
Hymenoptera .... bees, wasps, ants
Diptera .... flies, gnats, midges
Siphonaptera .... fleas

Several of the Orders are grouped differently in other books. For example, Orthoptera may be split into the Orders Blattaria (cockroaches), Grylloblattaria (rock crawlers), Phasmida (walking sticks and leaf insects), and Mantodea (Mantids). Hemiptera may be split into the Hemiptera (true bugs) and Homoptera (cicadas, aphids, whiteflies). and Phthiraptera is sometimes split into Mallophaga and Anoplura.

It takes a lot of learning and experience to be able to know to which of these orders any insect belongs. The following key, modified from the 1952 U. S. Department of Agriculture Yearbook "Insects", will help you learn the different orders of insects and enable you to place most insects in the order to which they belong. It will also enable you to identify many common specimens to the next level of classification, the family, since it includes about thirty of the larger and commoner families. There are, of course, many thousands of families altogether.

When putting pinned insects into specimen boxes it is best to put all the butterflies and moths (Lepidoptera) in one section, all grasshoppers (Orthoptera) in another, all flies and mosquitoes (Diptera) in another, and so on. It helps, too, if you pin a label on the bottom of the box telling which section is which order. In fact, after collecting insects for a while you will need several specimen boxes. Then for large orders such as Lepidoptera and Coleoptera you can have a special box. Arranging your collection in this manner will make it look much neater and more scientific.

Key to Major Groups Containing Common Insects

Note: you may need a 10X hand lens or a stereomicroscope to see some of the features on the insects.

1. Wings present, the front wings often in the form of hard, leathery or horny wing covers 2

   Wings absent or represented only by minute pads or buds 43

2. With only one pair of wings, these always membranous..........................3

With two pairs of wings, the front pair often represented by hard wing covers beneath which the hind wings are concealed in repose 8

3. End of abdomen with two or three slender but conspicuous, long projecting filaments...........................4

End of abdomen without such filaments. **Order Diptera** (mosquitoes, midges, flies) 5

4. Wings with a network of veins, including many cross veins. ....**Order Ephemeroptera** (mayflies), in part (figure 9).

Wings with very few longitudinal veins and no cross veins...................... **Order Hemiptera** in part (males of scale insects or Coccidae)

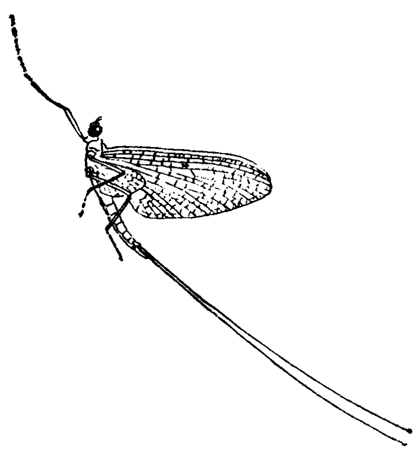


Figure 9

5. Antenna very short, usually three segmented, the last segment the longest and provided with a conspicuous, long bristle or with a number of rings or annulations. **Suborder Brachycera**..................... 6

Antenna longer and composed of many segments; body generally slender wings narrow .... **Suborder Nematocera** (midges, crane flies, mosquitoes, figure 10)

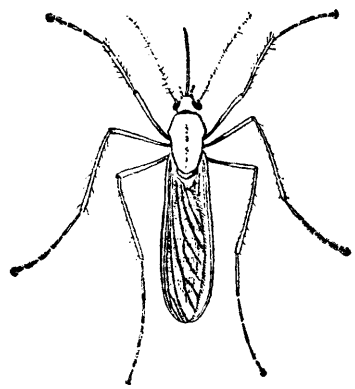


Figure 10

6. Last segment of antenna ringed or annulated and without a conspicuous long bristle (arista) at base. ....**Infraorder Orthorrhapha** (bee flies, robber flies, horse flies) (figure 11)

Last segment of antenna with a long bristle (arista) on upper side at base **Infraorder Cyclorrhapha**............... 7

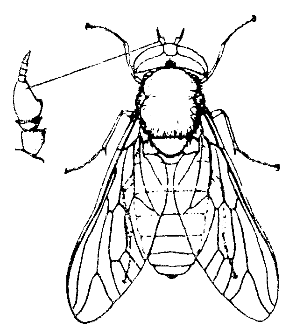


Figure 11

7. Calypter (scalelike structure behind base of wing) large and conspicuous; mesonotal suture complete; larger flies.............**Calypterate Muscoidea** (house flies, blow flies, flesh flies and their relatives) (figure 12)

   Calypter small and inconspicuous; mesonotal suture incomplete; mostly small flies, much smaller than house fly. ....**Acalypterate Muscoidea** (eye gnats, pomace or vinegar flies, fruit flies) (figure l3)

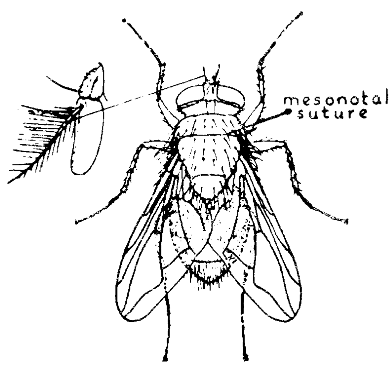


Figure 12

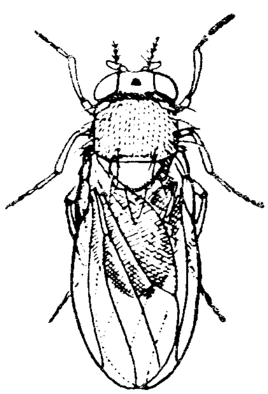


Figure 13

8. Front wings horny, rigid, opaque, without veins, meeting in a line over middle of body and concealing the membranous hind wings 9

   Front wings usually membranous although often covered with scales or hairs; if leathery, with the veins distinct, and not meeting along a line over middle of body 16

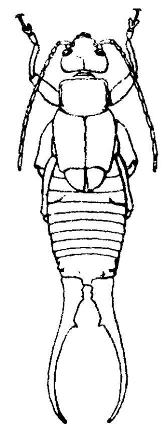


Figure 14

9. Tip of abdomen with a pair of prominent forceps-like appendages; front wings (wing covers) very short .... **Order Dermaptera** (earwigs) (figure 14)

   Tip of abdomen without such appendages;. front wings (wing covers) usually covering most or all of abdomen although sometimes short ......**Order Coleoptera** (beetles) 10

10. Front of head produced into a beak. ....**Family Curculionidae** (weevils) (figure 15)

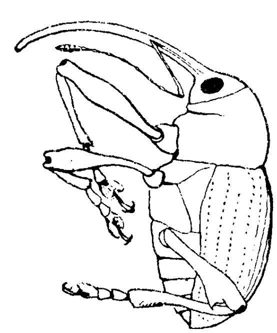


Figure 15

Front of head not produced into a beak 11

11. Wing covers very short, leaving last five or more of the abdominal segments exposed ....**Family Staphylinidae** (rove beetles) (figure 16)

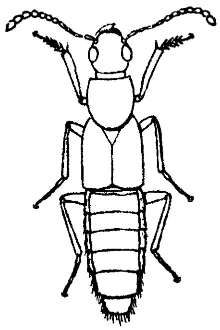


Figure 16

Wing covers extending to or near tip of abdomen, rarely leaving three segments exposed............................12

12. Antennae enlarged toward tips........13

Antennae not enlarged toward tips slender, sometimes longer than the body...15

13. Antennae lamellate (segments composing the club in the form of leaflike plates) ....**Family Scarabaeidae**

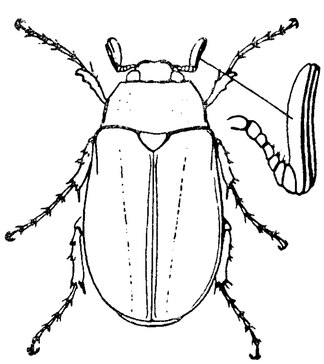


Figure 17

(May beetles, Japanese beetle, rose chafer, etc.) (figure 17).

Antennae not lamellate.................. 14

14. Tarsi apparently three-segmented .... **Family Coccinellidae** (lady beetles) (figure 18)

Tarsi four-segmented.......................... ....**Family Dermestidae** (larder beetles, carpet beetles) (figure 19)

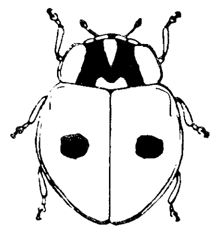


Figure 18

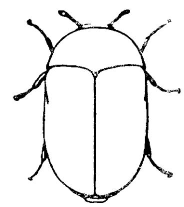


Figure 19

15. Tarsi five-segmented, the third segment not enlarged, antennae shorter than body .... **Family Carabidae** (ground beetles) (figure 20).

Tarsi apparently four-segmented, the third segment greatly enlarged and deeply cleft concealing the very small fourth segment; antennae usually longer than body .... **Family Cerambycidae** (long-horned beetles) (figure 21).

16. Front wings more or less leathery or

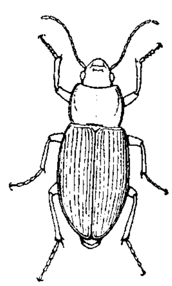


Figure 20

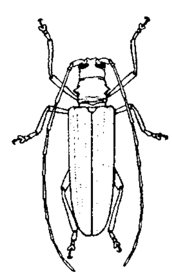


Figure 21

parchment-like 17

Front wings membranous................23

17. Mouth parts in the form of a piercing and sucking beak.................................
Order Hemiptera, in part 18

Mouth parts fitted for chewing............
Order **Orthoptera**............................19

18. Front wings leathery only at base, the apical third or more abruptly membranous and overlapping; beak arising from front part of head .... **Suborder Heteroptera** (true bugs) (figure 22).

Front wings of same thickness throughout and usually sloping rooflike over the body......................... .... **Suborder Homoptera,** in part (leafhoppers and their allies) (figure 23).

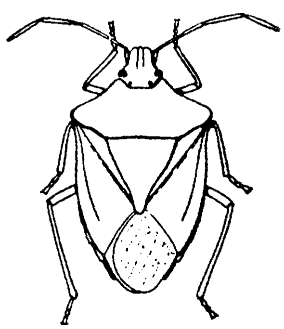


Figure 22

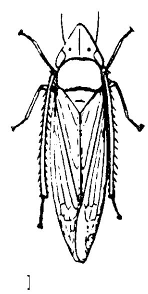


Figure 23

19. All legs slender, similar in form; body flattened from above. ....**Family Blattidae** (roaches) (figure 24)

Either the front legs or the hind leg greatly modified and very different in form from the others.................. 20

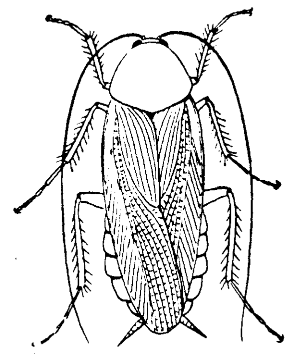


Figure 24

20. Front legs greatly enlarged and spined, fitted for seizing and holding prey; prothorax long and slender, head broad and capable of free movement ....**Family Mantidae** (mantids) (figure 25)

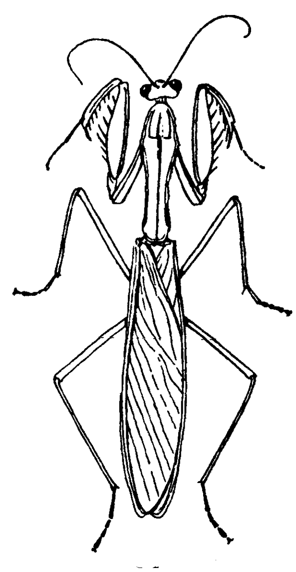


Figure 25

Front legs normal; hind legs fitted for jumping, the femora much enlarged 21

21. Antennae short, much shorter than body ....**Family Acrididae** (grasshoppers) (figure 26).

Antennae longer than the body 22

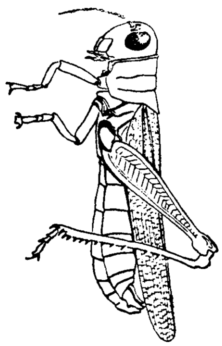


Figure 26

22. Tarsi four-segmented ....**Family Tettigoniidae** (long-horned grasshoppers, katydids, etc.) (figure 27).

Tarsi three-segmented......................... ....**Family Gryllidae** (crickets) (figure 28).

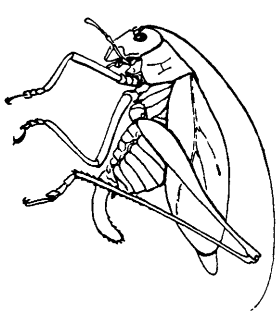


Figure 27

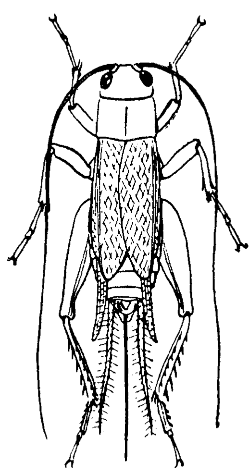


Figure 28

23. Wings covered with overlapping scales, often in beautiful color patterns .... **Order Lepidoptera** (moths and butterflies)................... 24

Wings not covered with scales 26

24. Antennae usually threadlike or feathery, not enlarged at tips wings, in repose, held rooflike over body, body very hairy. Mostly night-flying insects ....**moths** (figure 29)

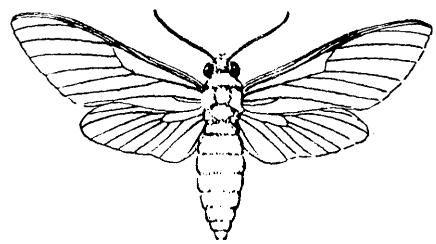


Figure 29

Antennae enlarged at tips; wings, in repose, usually held in a vertical position, or the forewings erect and the hind wings more or less horizontal, body not especially hairy. Mostly day-flying ....**skippers and butterflies**

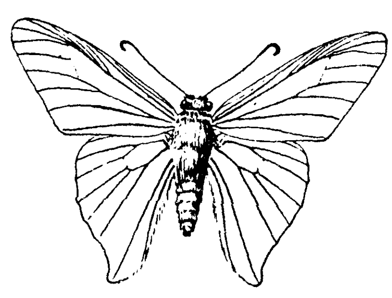


Figure 30

25. Extreme tips of antennae recurved or hooked. .... **Family Hesperiidae** (skippers) (figure 30).

Extreme tips of antennae knobbed. .... **Family Papilionidae** and allies (butterflies) (figure 31)

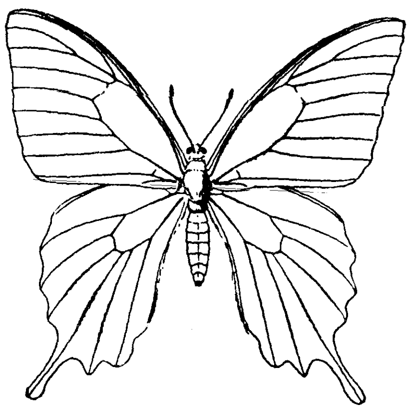


Figure 31

26. Wings very narrow, bladelike and fringed with long bristles; tarsus ending in a large bladderlike structure. .... **Order Thysanoptera** (thrips) (figure 32)

Wings not bladelike; tarsus without such a bladderlike structure.............27

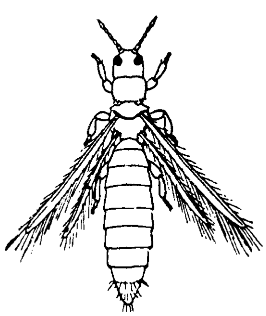


Figure 32

27. Mouth parts in the form of a beak fitted for piercing and sucking Hemiptera, in part........................... 28

Mouth parts fitted for chewing....... 29

28. Front wings lacelike, horizontal and overlapping in repose; small, flattened insects ..... **Family Tingidae** (lace bugs) (figure 33).

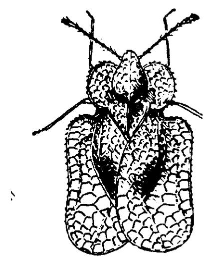




Figure 33 **Figure 34**

Front wings not lacelike, usually sloping and not overlapping in repose ....**Families Cicadidae** (cicadas) (figure 34), ...**Aphidae** (plantlice) (figure 35), and their relatives.

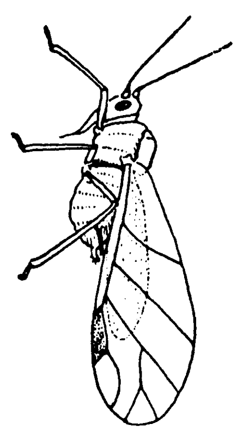


Figure 35

29. Wings with numerous longitudinal veins and many cross veins forming a network..30

Wings with few cross veins and usually with few longitudinal veins, not net-veined.................................35

30. Antennae very short and inconspicuous, composed of few segments..31

Antennae conspicuous, composed of many segments................................33

31. Hind wings very small, tip of abdomen with two or three long thin filaments...... **Order Ephemeroptera**, in part (mayflies)

Front and hind wings of about equal size; abdomen without terminal filaments.................. **Order Odonata** 32

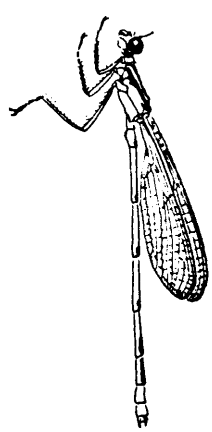


Figure 36

32. Front and hind wings similar in shape, slender at bases, wings, in repose, held in a vertical position over abdomen ..**Suborder Zygoptera** (damselflies) (figure 36)

Hind wing much broadened at base, wings, in repose, horizontal, extended outward .... **Suborder Anisoptera** (dragonflies) (figure 37).

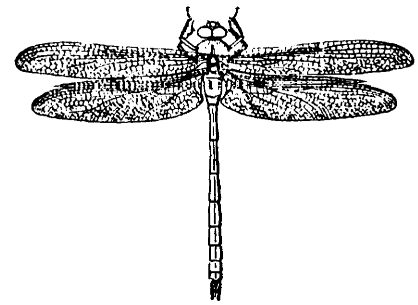


Figure 37

33. Wing veins mostly membranous and faint, front and hind wings of same size and shape, tarsi four-segmented .... **Order Isoptera** (termites) (figure 38, winged form)

Wing veins strongly developed...... 34

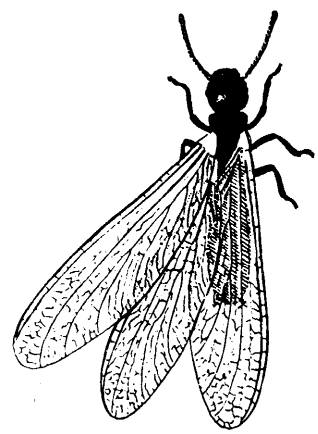


Figure 38

34. Tarsi two-or three-segmented ....**Order Plecoptera** (stoneflies) (figure 39).

Tarsi five-segmented.......................... .... **Order Neuroptera** (lacewings, (figure 40) dobsonflies (figure 41), etc.).



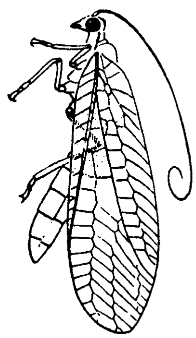


Figure 40

Figure 39

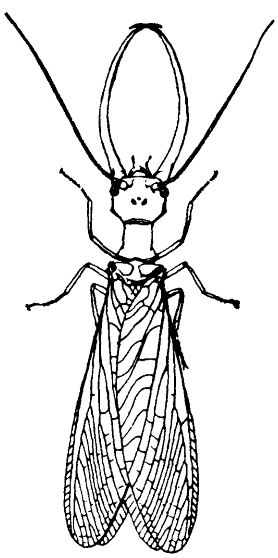




Figure 42

Figure 41

35. Tarsi five-segmented...................... 36

Tarsi two- or three-segmented ....**Order Pscoptera** (psocids or book lice)

36. Wings covered with fine long hair and held rooflike over abdomen, in repose..................**Order Trichoptera** (caddisflies) (figure 42)

Wings membranous and transparent, not covered with long hairs, not held rooflike over abdomen in repose........ **Order Hymenoptera** 37

37. Abdomen broadly joined to the thorax............... **Suborder Symphyta** (sawflies, wood wasps) (figure 43)

Abdomen more or less constricted at base.. 38

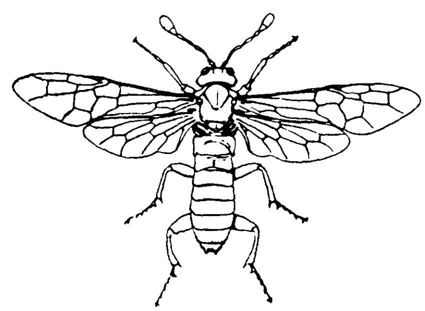


Figure 43

38. Petiole of abdomen (basal part by which abdomen is attached to thorax) composed of a single vertical platelike segment or of two narrow segments that are conspicuously set off from the remainder of the abdomen ....**Family Formicidae**. (ants) (figure 44, winged form)

Petiole of abdomen not as above.... 39

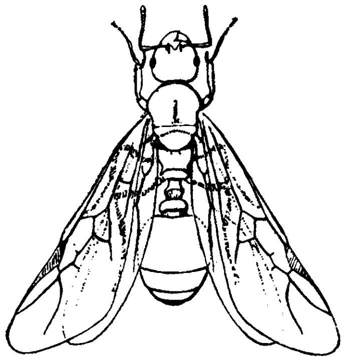


Figure 44

39. Front wing without a stigma (a more or less triangular, opaque, often discolored spot behind middle of front margin) .... **Superfamily Chalcidoidea**, etc. (chalcid flies and their relatives) (figure 45).

Front wing with a stigma 40

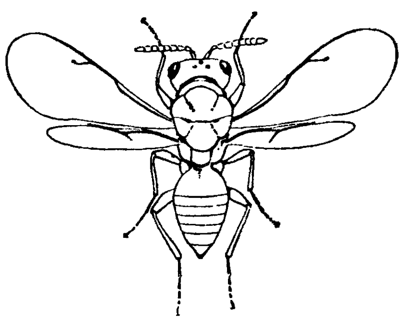


Figure 45

40. Body hairy, the hairs branched; first segment of tarsus often greatly broadened and fitted for gathering pollen .... **Superfamily Apoidea** (bees) (figure 46)

Body usually not so hairy, the hairs not branched 41

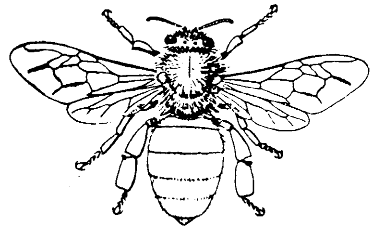


Figure 46

41. Wings folded lengthwise when in repose......................**Family Vespidae** (wasps and hornets) (figure 47)

Wings not folded lengthwise when in repose 42

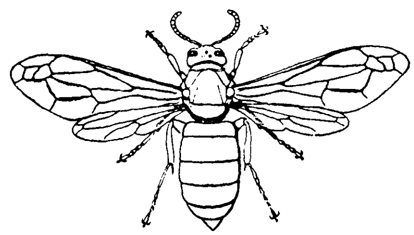


Figure 47

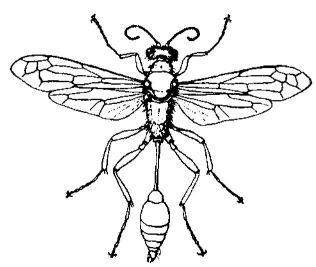


Figure 48

42. Antennae short, composed of 12 or l3 segments; female without a projecting ovipositor ....**Superfamily Sphecoidea** (thread-waisted wasps) (figure 48)

Antennae usually long and slender, composed of many segments, female usually with a projecting ovipositor.... .... **Superfamily Ichneumonoidea** (ichneumon flies) (figure 49)

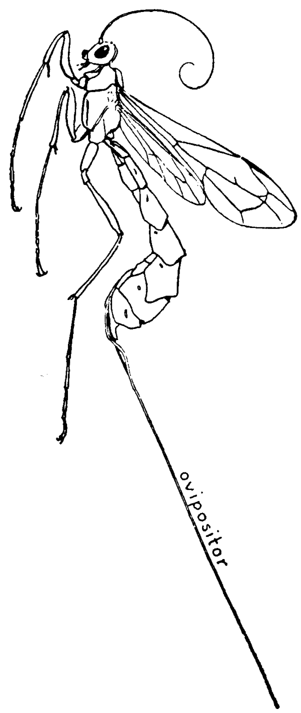


Figure 49

43. Tip of abdomen with two or three long appendages directed backward 44

Tip of abdomen without such appendages 45

44. Abdominal appendages thick, rigid, in the form of forceps.......................... .... **Order Dermaptera**, in part(earwigs)

Abdominal appendages delicate flexible, antenna-like........................... .... **Order Thysanura** (silverfish, etc.) (figure 50).

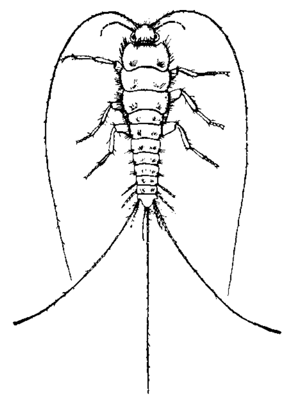


Figure 50

45. Tarsus composed of only one to three segments 46

Tarsus composed of four or five segments 50

46. Antennae conspicuous, projecting in front of head 47

Antennae very short, inconspicuous not projecting in front of head........ 49

47. Antennae composed of three to six segments 48

Antennae with more than six segments; very tiny insects that sometimes occur by the thousands in damp houses ....**Order Psocoptera** (psocids, book lice) (figure 51)

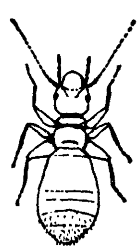


Figure 51

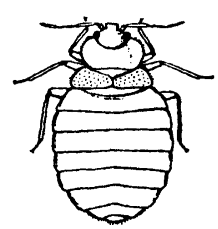


Figure 52

48. Mouth parts in the form of a distinct beak; body greatly flattened .... **Order Hemiptera, Family Cimicidae** (bed bugs) (figure 52)

Mouth parts not in the form of a beak; body not flattened... **Order Collembola** (springtails and snowfleas) (figure 53)

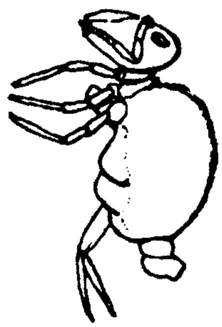
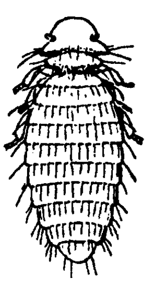


Figure 53

49. With biting or chewing mouth parts ....**Order Phthiraptera, Suborder Mallophaga** (biting lice) (figure 54)

With piercing and sucking mouth parts ....**Order Phthiraptera** ....**Suborder Anoplura** (sucking lice) (figure 55)



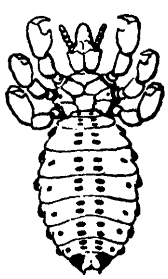


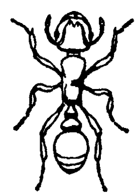
Figure 54 **Figure 55**

50. Antennae prominent 51

Antennae inconspicuous, not projecting 52

51. Body noticeably constricted at base of abdomen, antennae elbowed, the basal segment very long, tarsus five-segmented........**Order Hymenoptera Family Formicidae** (ants) (figure 56, wingless form)

Body not constricted at base of abdomen; antennae not elbowed, basal segment short, tarsus four-segmented................. **Order Isoptera** (termites) (figure 57, wingless form)



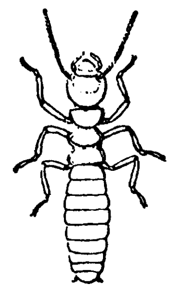


Figure 56 **Figure 57**

52. Body strongly compressed from the sides; abdomen distinctly segmented; coxae very large and strongly flattened; legs fitted for jumping.. **Order Siphonaptera** (fleas) (figure 58)

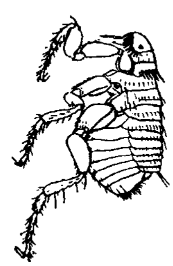


Figure 58

Body flattened top to bottom; abdomen not distinctly segmented; legs not fitted for jumping...**Order Diptera**, in part, wingless forms (sheep ked and its relatives)

REFERENCES AND ACKNOWLEDGMENT

This guide does not explain everything you will want to know about insects, It should merely serve as an introduction to insect collecting. To find out more about insects ask your teachers for information on reference books about insects, and also go to your public library and borrow the books that are available there. Local bookstores carry a number of titles such as the Petersen Field Guide series and Audubon Society Field Guide Series, both of which include a number of inset titles. Here are the titles of some other useful books:

1. **Bird, C.D., Hilchie, G.J., Kondla, N.G., Pike, E.M. and Sperling, F.A.H. 1995.** *Alberta Butterflies.* The Provincial Museum of Alberta, Edmonton. 347 pp.

2. **Borror, D.J., Triplehorn, C.A., and Johnson, N.F. 1989**. *An Introduction to the Study of Insects*. 6th ed. 875 pp.

3. **Clifford, H.F. 1991.** *Aquatic Invertebrates of Alberta.* University of Alberta Press, Edmonton. 538 pp.

4. **Ehrlich, P.R. and Ehrlich, A.H**. **1961.** *How to Know the Butterflies.* Wm. C. Brown Company, Dubuque, Iowa. 262 pages.

5. **Evans, H.E. 1984.** *Insect Biology* Addison-Wesely, Reading, Massachusetts.

6. **Martin, J.E.H. 1977.** *The Insects and Arachnids of Canada. Part 1. Collecting, Preparing, and Preserving Insects, Mites, and Spiders.* Canada Department of Agriculture Publication 1643. 182 pp.

7. **Romoser, W.S. and Stoffolano, J.G., Jr. 1994.** *The Science of Entomology*. Wm. C. Brown, Dubuque, Iowa. 532 pp.

Persons who want to buy equipment can write to one of the natural history supply houses whose addresses follow, and ask for their price lists of insect collecting equipment. Also, local nature and science stores carry entomological equipment.

Ward's Natural Science Ltd.
399 Vansickle Road
St. Catherine’s, Ont.
L25 3T5

BioQuip
17803 LaSalle Avenue
Gardena, California
90248-3602 USA.

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